

## **farms and farming**

The production of food and fiber from the soil, farming is a slow biological process involving soil cultivation, planting, harvesting, and the disposition of the harvest. Closely related to farming are herding, ranching, the cultivation of orchards, tree farming, and FISH FARMING, or aquaculture.

Throughout history, farming has been the occupation of nine-tenths or more of humankind. Painfully slow progress in farming techniques eventually provided surpluses beyond the needs of the producers, freeing many for the nonfarming pursuits that eventually created societies based on technology rather than food production. The farmer's surplus, then, is fundamental to civilization. Even today, however, more than half the world's population of about five billion people are still engaged in farming.

Farming can be carried on only where climate and soil are favorable. It is necessarily limited to areas of productive soils, tillable topography, adequate moisture from precipitation or irrigation, and a growing season long enough for plant germination and maturation. There are a few especially advantaged areas that have the natural resources to build an extensive system of highly productive farms. Taken overall, the United States is one such area.

Within the natural environmental conditions necessary for farming there are wide variations that determine the crops produced, the techniques employed, and the type of farm organization. In addition, regional history, tradition, folk wisdom, level of knowledge, and incentive for gain have multiplied the differences among farming practices from place to place and time to time. Today, however, diminishing isolation has resulted in the diffusion and exchange of plants, animals, tools, and knowledge, and—at least where economic and agricultural conditions are similar—a growing similarity of agricultural practices. Nevertheless, crop belts like the corn-hog belt in the midwestern United States, special niches like the Rhine vineyards of Germany or the rubber tree groves of Malaysia, along with hundreds of other distinctive farm areas, continue to produce immensely diverse patterns among the world's farms.

Primitive SLASH AND BURN farming is still practiced in remote areas. Subsistence and small-village agriculture is the pattern in much of the developing Third World. Mixed or general-family farms with crops and livestock interrelated, and with the resources to reach commercial markets, have dominated agriculture in the developed countries in the 19th and 20th centuries. Plantations producing staple crops for sale in world markets are a feature of tropical and subtropical regions. Highly capitalized farming operations, they are not significantly different from large-scale one-crop corporation farms.

Farming is a production process that requires much care and attention, and farms have usually been family operations, where all the family members contribute as much labor as is needed to produce crops. Other forms of organization—communes, collective farms, cooperative farms, special structures like the Israeli kibbutz, and corporation farms—have appeared where government authority or cultural or ideological pressure has intervened.

## **FARMING IN THE WESTERN WORLD**

Techniques of farming evolved in response to population pressure, invention, selection of crops and animals, available human and animal or mechanical power, supply of arable land, and, eventually, the pull of market demand.

Beginning with the digging stick, the hoe, the sickle, and the earliest domesticated plants of the NEOLITHIC PERIOD about 10,000 years ago, farming evolved with painful slowness, as animals were domesticated, the ard (a primitive plow) and the flail were invented, fruit and nut trees cultivated, and irrigation became a standard practice. Shifting slash-and-burn techniques were succeeded in Europe by a two-field system that alternated crops with fallow fields. The succeeding three-field system used late in the Middle Ages increased production nearly 17 percent. Along the way, the ard was replaced by a real moldboard PLOW made of wood and iron, which turned over rather than simply scratched the earth. The scythe improved upon the sickle, and the horse-collar allowed the quicker horse to replace the ox as a draft animal. The narrow strips of land cultivated by medieval village farmers provided bare subsistence. The ENCLOSURE of these divided fields into larger fields devoted to a single crop led to more efficient production of marketable crops. The enclosure movement eventually brought about the elimination of fallow fields and the introduction of the practice of crop rotation.

## **19th-Century Farm Technology**

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## Land and Farming

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Throughout history, farming has been the occupation of millions of people. In many parts of the world, farming is still a family affair. In farming techniques eventually provided surplus beyond the needs of the producers, leading many for the nonfarming pursuits that eventually created societies based on technology rather than food production. The farming surplus, then, is fundamental to civilization. Even today, however, more than half the world's population of about two billion people are still engaged in farming.

Farming can be carried on only where climate and soil are favorable. It is necessarily limited in areas of productive soils, fertile topography, adequate moisture from precipitation or irrigation, and a growing season long enough for plant germination and maturation. There are a few especially disadvantaged areas that have the natural resources to build an extensive system of highly productive farms. Taken overall, the United States is one such area.

Within the natural environmental conditions necessary for farming there are wide variations that determine the crops produced, the techniques employed, and the type of farm organization. In addition, regional history, tradition, folk wisdom, level of knowledge, and incentive for gain have multiplied the differences among farming practices from place to place and time to time. Today, based on scientific knowledge, the differences in the utilization and management of plants, animals, soils, and knowledge, and at least where economic and ecological conditions are similar, a growing number of agricultural practices have been developed. These include the intensive farming systems of the United States, special niches like the Rhine vineyards of Germany or the rubber tree groves of Malaysia, along with hundreds of other distinctive farm areas, combined to produce immensely diverse patterns among the world's farms.

Primitive CLASH AND BURN farming is still prevalent in remote areas. Subsistence and small village agriculture is the pattern in much of the developing Third World, linked to generally family farms with crops and livestock. Industrialized, and with the resources to reach commercial markets, have dominated agriculture in the developed countries in the 19th and 20th centuries. Primitive subsistence agriculture is still practiced in some areas, but in large-scale one-crop plantation farms, highly mechanized farming operations, they are not significantly different from

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## FARMING IN THE WESTERN WORLD

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Beginning with the digging stick, the hoe, the sickle, and the earliest domesticated plants of the NEOLITHIC PERIOD about 10,000 years ago, farming evolved with gradual steadiness, as animals were domesticated (the ox and the plow) and the fallow was invented, and irrigation became a standard practice. Shifting slash-and-burn techniques were succeeded in Europe by a two-field system that alternated crops with fallow fields. The succeeding three-field system used fallow, the Middle Ages increased production nearly 15 percent. Along the way, the hoe was replaced by a real moldboard PLOW made of wood and iron, which turned over, rather than simply scratched the earth. The ox was replaced by the horse, and the horse collar allowed the ox to replace the ox as a draft animal. The narrow strip of land cultivated by medieval village farmers provided bare subsistence. The ENCLOSURE of these divided fields into larger fields devoted to a single crop led to more efficient production of arable crops. The enclosure movement eventually brought about the elimination of fallow fields and the introduction of the practice of crop rotation.

## 18th-Century Farm Technology

The great progress in science and technology during the late 16th and 17th centuries transformed agriculture in

Western Europe and North America. Expanded knowledge of agricultural chemistry led to improved practices of fertilization and of livestock feeding. Plant and animal breeding by selection of desirable features increased productivity (see ANIMAL HUSBANDRY). Growing urban markets that could now be reached by canals, railroads, and steamboats invited farmers to maximize production for material gain. The cotton gin and steam-powered sugar mills and grain-threshing machines transformed methods of growing crops that had once been highly labor-intensive.

A great age of horse-powered farm machinery dominated Western European and American agriculture until early in the twentieth century. Horses pulled steel plows, harrows, cultivators, mowers, hay rakes, and reapers; they activated threshing machines and combines and performed many other farm jobs. Elaborate horse-powered farm machinery vastly increased labor productivity and brought new lands under cultivation. Horse power applied to farming had developed as far as it could by the time horses were replaced by the internal combustion engine early in the 20th century.

Mechanical power led to another farming revolution in the developed countries. In the United States between 1910 and 1960 about 36,420,000 ha (90,000,000 acres) were freed from growing the hay that fueled horses, and were shifted to other crops. Tractors, autos, trucks, combines, irrigation pumps, milkers, aerial crop dusters, and vegetable harvesters further increased labor productivity and gross volume while allowing farm size to grow and encouraging farm specialization.

At the same time as the mechanical revolution was taking place in farming, the application of biological and chemical science to crop improvement was increasing both the quality and quantity of agricultural output. The science of genetics produced hybrid corn, more productive poultry and dairy cattle, and—since World War II—the "miracle" rices and wheats of the GREEN REVOLUTION. Recently developed techniques of genetic engineering hold out promise for still greater gains. Insecticides, fungicides, herbicides, growth regulators, and antibiotics have made farming a "high tech" enterprise. Chemical fertilizer applications soared with cheapened production by the petrochemical industries.

### The U.S. Family Farm

About 1900 the family farm (at least, the farm that has remained in the American collective memory as the "ideal" family farm) measured about 65 ha (160 acres), was largely self-sufficient and produced modest quantities of surplus products for sale. The farm family provided most, if not all, of the labor required except during harvest, when a harvesting crew might be assembled from the neighborhood. Horses for power and other livestock were bred and fed on the farm. Established routines allowed for the field rotation of hay, pasture, oats, corn, and wheat that conserved soil resources. Dairy cattle, pigs, and poultry provided salable goods as well as farm food. Livestock manure fertilized the fields. Basic machinery—the plow, harrow, harvester, and mower—was relatively simple and might be repaired and maintained on the farm itself. Farm structures—house, privy, barn and silo, corn crib, hoghouses, equipment shed, fences—were equally uncomplicated, and some could be built by the farmer and his family. Crop production, upkeep of harness, machinery, and structures, the care of the animals, milking, and housekeeping kept the family labor force fully occupied and tied to daily and seasonal rounds of toil.

Farm families lived on their farms and not in villages, as was (and is) common in much of Europe and the Third World. When farms averaged 65 ha, the distance between farmhouses was 0.8 km (0.5 mi). Such dispersed settlement isolated farm families. Yet these distances could be overcome by trading labor at harvest time, exchanging special skills like butchering and horse training, and by participating in community schools and churches.

The norm primarily in the Midwest for the generations between the Civil War and World War II, the 65-ha family farm exemplified the American ideal of independence. Equally numerous in other sections of the country, however, were small, poor farms on the margins of good land, and tenant farms—particularly in the cotton-raising South—where farmers worked land they did not own in exchange for a share of the crops they raised. As a symbol of rural poverty, the Southern sharecropper vanished in the years following World War II (largely as the result of the mechanization of cotton cultivation). The rental of land for cash, or for a share of the crop, however, is a practice that still persists.

### Changes in U.S. Farm Structure

Technological change in farming has proceeded hand in hand with industrialization and urbanization. In fact, progress in farming was long considered a measure of society's modernization.





The increase in field and farm size to accommodate new technologies—such as harvester combines or tomato harvester machines—has meant a decline in the number of farms and a reduction of the farm labor force. Gains in gross production volume and production per worker, per hectare, and per animal unit released labor for nonfarm pursuits and provided ample and relatively cheap food for urban populations.

The United States provides the most notable measurements of the changes in farming that have occurred throughout the industrialized West. From 1950 to 1980, U.S. farm output doubled. The average size of farms grew from 87 to 182 ha (215 to 450 acres), the number of farms fell from 5.6 to 2.4 million, and the farm population shrank from 23 to 6 million (from 15 percent to 2.7 percent of the total population). At the same time, the number of persons supplied with farm products grew from 15 to 65 for each farm worker. In the mid-1990s, among the approximately 1.8 million farms, the top 15 percent in terms of size produced almost 80 percent of gross farm income. At the other end, the smallest farms—representing over 50 percent of all farms—produced only 5 percent of total farm income.

Although the decline in the number of farms began to slow after 1980, the number of people who earned their livelihoods solely from farming continued to shrink. About 45 percent of all U.S. farm families now derive more income from nonfarm sources than from the sale of farm products.

Today a successful family farm is a commercialized and specialized business, highly capital- and energy-intensive. It concentrates on the production of one or two commercial crops (corn, for example, or soybeans, pigs, beef cattle, or milk). It utilizes machinery to the fullest extent on ever-larger fields and depends on borrowed capital for the purchase of equipment, seeds, fertilizer, and pesticides to maximize yields on expensive land. Management skills of a high order are required to succeed in this type of farming. A representative midwestern farmer, for example, could have a capital investment in land and equipment of \$1.5 million and sell crops worth \$300,000. Net income on such a farm—depending on production costs, weather, market demand, and other factors—might be \$30,000 or less.

Commercial family farms are sometimes incorporated to gain tax and management advantages, but they remain family businesses. Public corporations have ventured into specialized farming operations that benefit from expansion of scale. Big corporation farms grow fruits and vegetables in California and cotton in California, Texas, and Mississippi; they fatten thousands of cattle in feedlots and raise poultry in factories. The displacement of family farms by corporations has inspired some public concern; although an increasing percentage of products are grown by corporation farms, high capital and operating costs have restrained their growth somewhat (see AGRIBUSINESS).

### Changes in Farm Economics

The increase in farm size and productivity has been both the cause and the result of the increased dependence on the input industries that supply machinery, chemicals, and feed and seed. In the United States particularly, the temptation to buy more acreage in order to use farm machinery to its full potential (and to buy larger machinery so that the increased acres can be efficiently cultivated) has brought many farmers close to bankruptcy, especially in periods of lowered farm income.

Farm products today are no longer directly consumable goods. Rather, they are raw materials that will be factory processed, packaged, and merchandised. For example, much of the corn grown in the United States is used for livestock feed for the meat-packing and distributing industry. Wheat is shipped long distances to flour mills, then to mass-production bakeries, then to retail stores. Fruits and vegetables—when not processed and canned or frozen—move from the farmer to packers and middlemen handlers before reaching store shelves. In the United States, distribution charges interposed between the farmer and the consumer have reduced the farmer's share of the consumer's food dollar to about 36 cents.

Farming is necessarily a slow process, even where two or three crops can be grown annually. In the United States, one crop a year is the norm in most areas. Trees and vines require three or more years to come into bearing. The pig crop takes nearly a year from breeding to sale weight; beef cattle require two or more years. The farmer's turnover is slow compared to that of commerce and industry, and in addition, the hazards of nature bear heavily upon farms.

Unlike industry, in farming increase in size does not necessarily produce increased efficiency. Optimum farm size varies with differing crops and locations. The most efficient U.S. dairy farms in the 1980s, for example, maintained



about 300 cows on about 120 ha (300 acres). Larger herds increase volume but do not raise efficiency or lower costs.

More than 200 commercial crops are grown on U.S. farms under widely different geographical and economic conditions. Wheat farmers of the Great Plains and the Palouse region of Washington and Oregon have arrangements for seeding, irrigation, and harvest that are unique to their climate, soil, and geography. Wine-grape farmers in California and upper New York State cope with the vagaries of consumer tastes, as well as with the weather. Citrus farmers in California, Texas, and Florida depend on organized marketing to maintain prices. Farmers who produce processing tomatoes and potatoes plan their crops in response to the demand of fast-food outlets for ketchup and tomato paste, French fries and chips.

### Areas of Specialized Farm Production

Farms tend to specialize according to climatic and soil conditions, and according to their location with respect to markets and sources of production materials. Dairy farms are concentrated in the Northeast, around the Great Lakes, and near large cities. Cattle and sheep ranches are located in arid regions from the Rocky Mountains westward and in other regions where there are large supplies of hay and grasses. Specialized wheat farms are found in the Great Plains and in the Northwest.

Corn and soybean production is the foundation of farming on the rich lands of the central region known as the Corn Belt. Many farms specialize in producing only these two grains. However, since soybeans and corn are the main feed for hogs and for fattening cattle, many Corn Belt farms also produce hogs and import beef cattle from ranches in the West for fattening. In recent years cattle fattening has become more concentrated in large-scale specialized units of the Corn Belt and in the sorghum-grain and irrigated regions of the Southern Plains.

Cotton is limited by climate to the southern and southwestern states. Fruits and vegetables are produced mainly where local climate is favorable. Year-round vegetable production is found primarily in Florida and California. Poultry is produced in large specialized units concentrated especially in states that have access both to feed supplies and to consuming centers. However, some farms produce several commodities throughout the year, in order to utilize labor and other resources efficiently.

### THE ROLE OF GOVERNMENT

Farming figures importantly in the governmental policies of most nations. Farms are the source of strategic food supplies, of important raw materials for industry, and of major commodities for trade and commerce. Farming interests, especially in the United States, possess considerable political power and influence.

Farm welfare has therefore had the solicitous attention of the United States government for many decades. In the 19th century it was assumed that easy distribution of land would encourage the development of productive farms. This idea culminated in the HOMESTEAD ACT of 1862, which gave 160 acres (65 ha) of public land each to settlers who declared their intention of building farms. By establishing support for research and education, the government hoped to make farms more productive and farm life more fulfilling. The creation of the U.S. Department of Agriculture (see AGRICULTURE, U.S. DEPARTMENT OF, and the passing of the MORRILL LAND GRANT COLLEGE ACT, both in 1862, were followed by the Hatch Act of 1887, which subsidized state agricultural experiment stations, and the Smith-Lever Act of 1914, which supported agricultural extension services in the states (see AGRICULTURAL EDUCATION).

The disadvantages of small-scale farming in an industrialized economy, especially evident at the time of the Great Depression of the 1930s, gave rise to federal efforts to support farm prices. A program to restrain the production of price-depressing surpluses and to raise prices to parity levels began with the Agricultural Adjustment Act of 1933 and became a central feature of government farm policy. The act declared that farm commodities should have the same purchasing power (parity) as they had in the period 1910-14. For example, the parity price of a bushel of corn should buy as much fertilizer, machinery, or other materials as a bushel of corn would have purchased during the base period. The base period for determining parity has changed several times since 1933, and the 1977 Food and Agricultural Act uses the cost of production rather than parity as a means of setting price supports.

At different times the government has also paid farmers to withhold land from production, has provided commodity loans above market prices to persuade farmers to keep crops off the market, and has paid farmers the difference between the target prices it considers fair and actual market prices. The 1983 PIK (Payment in Kind) program attempted to shrink government surplus commodity holdings by paying farmers who reduced their plantings of

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### THE ROLE OF GOVERNMENT

Farming is so important in the government of the United States that it is the source of strategic food supplies, of important raw materials for industry, and of major income taxes for trade and commerce. Farming interests, especially in the United States, possess considerable political power and influence.

Farm writers have therefore had the solicitude of the United States government for many decades. In the 19th century it was assumed that easy disposal of land would encourage the development of productive farms. The idea originated in the HOMESTEAD ACT of 1862, which gave 160 acres (65 ha) of public land each to settlers who accepted the condition of building houses. By erecting a building in support for research and education, the government hoped to make farms more productive and earn the more lasting. The creation of the U.S. Department of Agriculture (see AGRICULTURE, U.S. DEPARTMENT OF), and the passing of the MORRILL LAND GRANT COLLEGE ACT, both in 1862, were followed by the Hatch Act of 1887, which authorized state agricultural experiment stations, and the Smith-Lever Act of 1914, which authorized agricultural extension services in the states (see AGRICULTURAL EDUCATION).

The direct savings of small-scale farming in an industrial economy, especially evident in the time of the Great Depression of the 1930s, gave rise to federal efforts to support farm income. A program to restrain the production of price-depressing commodities and to raise prices for partly perishable farm commodities was established in 1933 and became a central feature of government farm policy. The act declared that farm commodities should have the same purchasing power (weight) as they had in the period 1910-14. For example, the partly price of a bushel of corn should buy as much fertilizer, machinery, or other materials as a bushel of corn would have purchased during the base period. The base period for determining prices was changed several times since 1933, and the 1910-14 base and Agricultural Act was the cost of production rather than partly as a means of setting price supports.

At different times the government has also sold in order to withhold land from production, has provided commodity loans above market prices to persuade farmers to leave crops off the market, and has paid farmers the difference between the market price and a government-set price. The 1933 FIC (Farm Income Stabilization) program attempted to limit government surplus commodity holdings by paying farmers who reduced their plantings of



wheat, rice, and cotton from government stockpiles of these commodities. The program, which cost about \$12 billion, did little to reduce the size of harvests or of government surpluses.

### **Importance of Farm Exports**

American farmers produce commercial crops in quantities that are far in excess of domestic needs. Much of the excess is stockpiled, while much more has been sold in foreign markets.

Since the beginning of colonial development, food and commodity exports have bolstered American growth. Tobacco, rice, indigo, and foodstuffs were major colonial exports. Exported cotton, wheat, and livestock products sustained the U.S. economy through the 19th and into the 20th centuries. After World War II, swelling farm productivity caused a great accumulation of surpluses, which were reduced through the Food for Peace program, begun in 1954, and through subsidized sales to Third World countries. Renewed demand for American wheat and feed grains during the decade 1970-80 moved surpluses abroad at good prices and encouraged U.S. farmers to plant more hectares. The first half of the 1980s, however, saw a U.S. grain embargo imposed against the USSR in retaliation for its invasion of Afghanistan; a world economic recession; and growing competition from other grain producers, such as Argentina. Wheat farmers, particularly, felt the negative economic effects of shrinking export markets. Nevertheless, one-quarter of U.S. farm production is still exported. Its receipts total an annual \$35-40 billion.

### **FARMING IN WESTERN EUROPE**

Western Europe has moved at a slower pace than the United States toward more efficient, larger, commercialized family farming operations. Specialized dairying, livestock, and poultry farmers, especially in Britain and the Netherlands, draw heavily upon purchased feed grain, much of it imported from North America. In France and Italy, and most of the other European Mediterranean countries, however, land consolidation as a means of using machinery effectively has not taken place, and the traditional small holding remains the norm.

The European Common Market (now the EU, or EUROPEAN UNION) was organized in 1958. Its principal purpose was to establish open markets for European products within the European community and to permit more efficient export marketing of farm surpluses. The price subsidies provided farmers by the EU, combined with more productive farming techniques, have made the EU a serious competitor with the United States and other food-exporting nations. The subsidies have also been one of the obstacles to the increased sale of U.S. food products within the EU and a source of U.S.-EU controversy.

### **NON-WESTERN TYPES OF FARMING ORGANIZATIONS**

Under central planning farming in the countries of Eastern Europe was organized in accord with Communist ideology. Big industrialized farms, state farms, and collective farms aimed to achieve economies of scale by covering great acreages of cropland with massive machinery and large numbers of workers. Efficiency was elusive under bureaucratic management, and production per worker and per acre in the USSR averaged about half that of Great Britain's farms. Since the collapse of Communist regimes in the late 1980s, efforts to privatize farming have worked relatively well in such countries as Poland and Hungary but have been far less successful in the republics of the former USSR.

The giant commune in China, which might take in the land and populations of several villages, became the standard Chinese farm organization after the 1949 revolution. It brought an initial sharp decline in production, although China later managed to regain near self-sufficiency in food. By the late 1980s, however, many Chinese farmworkers were being allowed to own their own plots of land, and the commune system seemed viable only for commercial crops like wheat.

Israel pioneered the KIBBUTZ, a form of cooperative farm that has been highly productive of food and specialty crops both for local consumption and export. The Mexican ejido is a cooperative village enterprise that leaves production to individual farmers but centralizes purchasing and marketing. The Israeli moshav functions in a similar fashion.

Plantations produce single crops—rubber, coffee, sisal, bananas, palm oil, pineapples, cacao—for sale to distant markets. Today, plantation farming is found primarily in tropical and semitropical countries. It is usually organized on a large scale and may be exploitive both of labor and, because only one type of crop is raised, of soil resources. Plantations growing profitable crops for export have often displaced small peasant farms, pushing small farmers

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Plantations produce single crops—rubber, coffee, rice, bananae, palm oil, pineapple, orange—for sale to distant markets. Tropical plantation farming is found primarily in tropical and semi-tropical countries. It is usually organized on a large scale and may be operated both of labor and because only one type of crop is raised of self-sufficiency. Plantations growing coffee for export have been displaced small peasant farms, pushing small farmers

back on marginal land or off the land altogether. Especially in regions of Central and South America and in parts of Africa, plantation economies have taken over so much land that not enough is left to raise food for local populations.

Village farming in the past, and in many regions in the present, has involved peasants cultivating small plots of land intensively, producing a diversity of intertilled food and fiber crops, and sustaining a large rural population. It rarely produces great surpluses. Many areas of subsistence peasant farming are close to maximum land productivity, and many peasant villages may live on the edge of malnutrition. Depleted soil and unfavorable climatic conditions have decimated peasant populations in many regions of Africa and Asia.

The green revolution produced high-yielding strains of rice, wheat, and corn and has transformed agriculture in Mexico and India, but the cultivation of these new grains is confined to wealthy farmers with large fields. The development of indigenous plants as crops for food and export, however, offers the possibility of new wealth for village farmers, especially in tropical regions. Little-known tropical fruits (the carambola or the pummelo, for example), the high-protein seeds quinoa and AMARANTH, and desert shrubs such as PRICKLY PEAR or kenaf (a hibiscus grown for its fiber)—as well as many other plants now ignored or grown only in small quantities—might become major crops in the future.

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See also: AGRICULTURAL ECOLOGY; AGRICULTURAL ECONOMICS; AGRICULTURE, HISTORY OF; AGRICULTURE AND THE FOOD SUPPLY.

